10/031729
JC13 Rec'd PCT/PTO 22 JAN 2002

MARKED UP COPY

Transition from a waveguide to a microstrip

~~State of the Art~~

1. Field of invention

The ~~present~~ invention relates to a transition from a waveguide to a microstrip, ~~wherein the~~ and more particularly, to a microstrip extending, on a substrate, project~~s~~ing through an opening into ~~the~~ a waveguide and a ground line associated ~~with~~ therewith, ~~the microstrip contacts the waveguide wall.~~

2. Description of the related art

~~Such~~ A transition from a waveguide to a microstrip is known from US 5,202,648. ~~In this connection, the~~ Wherein, a microstrip is extend~~s~~ed on ~~the~~ an upper side of ~~the~~ a substrate and ~~the~~ an associated ground line, consist~~s~~ing of a conductive surface on ~~the~~ an opposite side of the substrate ~~side which~~ contacts the waveguide wall.
A problem is that ~~One weak point of transitions between~~ a waveguide and a contact strip designed in this way ~~is~~ has a reflection attenuation ~~which~~ that is frequently too low and ~~also~~ a transmission attenuation which is too high.

What is needed is:
~~It is the underlying object of the invention to provide~~ a transition ~~of the kind first mentioned~~ which has the highest possible reflection attenuation and the lowest possible transmission attenuation.

~~Advantages of the Invention~~

Summary of the Invention.

~~In accordance with claim 1, the~~ A ground line associated with ~~the~~ a microstrip includes ~~consists of~~ a plurality of ground surfaces superimposed on one another all of which ~~all~~ contact one another by ~~means~~ way of through~~-~~contacts in ~~the~~ a substrate. The multi-layer ground line produces a more favorable field conversion from the microstrip to the waveguide, ~~w~~thereby a high reflection attenuation and a low transmission attenuation ~~arises for the transition.~~ results

~~Advantageous further developments of the invention can be seen from the dependent claims.~~

~~Since a~~ A through-plating is provided in the substrate at the end of the microstrip ~~acting~~ which acts as an antenna and which project~~ing~~s into the waveguide, thus the transition bandwidth ~~becomes larger.~~ is enlarged.

To ~~be able to~~ make a good contact between the multi-layer ground line and the waveguide wall, it is expedient for ground surfaces to be applied to the substrate ~~at~~ on both sides thereof, next to the microstrip and for these ground surfaces to be in contact with the ~~other~~ ground surfaces that are superimposed on one another in the substrate via through contacts (vias). Advantageously, the substrate is fixed, by at least one screw, on a support, on the waveguide wall, ~~with~~ the screw ~~being~~ is guided through the ground surfaces and ~~an~~ electrical contact ~~being~~ is made between the~~se~~ ground surfaces and the support. To the support

A low transmission attenuation is achieved ~~in that~~ by way of the at least one screw having ~~lies with~~ its head on one of the ground surfaces which is applied to the upper side of the substrate, ~~side at the side~~ next to the microstrip and ~~in that~~ by way of a conductive ribbon, ~~which~~ that is connected to the waveguide wall, the conductive ribbon being ~~is~~ clamped between the screw head and the ground surface. Alternatively, ~~to this,~~ at least one

conductive elastic body ~~can be~~ is inserted between one of the two ground surfaces located to ~~the~~ each side of the microstrip and a projection of the waveguide wall projecting over the ground surfaces. ~~Moreover,~~ Further, a conductive elastic body can be pressed ~~in~~ between the head of the at least one screw and the projection of the waveguide wall.

Drawing

The invention will be described in more detail in the following with reference to a plurality of embodiments shown in the drawing. There are shown:

Figure 1 a perspective illustration of a transition from a waveguide to a microstrip;
Figure 2 a longitudinal section A-A through the transition; and
Figure 3 a cross-section B-B through the transition.

~~Description of embodiments~~ Detailed Description of the Invention

Refering now to the drawings, and more particularly to ~~As can be seen from the~~ perspective schematic ~~diagram in~~ Figure 1, ~~a~~ there is illustrated a microstrip 2 ~~extends~~ on a multi-layer substrate 1. ~~An~~ Opening 4 is located in a side wall of ~~a~~ waveguide 3 and ~~a~~ tongue 5, ~~located at the~~ of substrate 1, projects ~~through it~~ into ~~the~~ waveguide 3. The ~~end~~ portion of ~~the waveguide~~ microstrip 2 which extend~~ing~~es on ~~the~~ tongue 5 ~~acts as an~~ is antenna 6 ~~for coupling the~~ which couples a waveguide field to ~~the~~ microstrip 2 and/or vice versa.

Now, Additionally referring to there is shown

~~As shown in more detail in~~ Figu~~res~~ 2 and 3 two ground surfaces 7 and 8, which are applied to the upper side of substrate, ~~side~~ next to ~~the~~ microstrip 2 ~~and, in addition,~~ A plurality of ground surfaces 9 are superimposed on one another within ~~the~~ multi-layer substrate, ~~and all~~ each having the same ground potential. ~~The~~ Cross-section B-B, through ~~the~~ waveguide 3 into ~~the~~ substrate 1, shown in Fig~~ure~~ 3 shows ~~the~~ multi-layer ground surfaces 9 within ~~the~~ substrate 1.

~~The~~ Longitudinal section A-A, shown in Fig~~ure~~ 2, shows ~~the~~ two symmetrical ground surfaces 7 and 8, ~~at both~~ respectively along each side~~s~~ of ~~the~~ microstrip 2. ~~These~~ Ground surfaces 7 and 8, on the upper side of substrate, ~~side~~ are connected in an electrically conductive manner by a plurality of through-contacts 10 to ~~the~~ other ground surfaces 9, which are superimposed on one another within ~~the~~ substrate 1. The position~~s~~ and spacing~~s~~ of ~~the~~ through-contacts 10 are selected such that a field propagation, into the intermediate areas between the ground surfaces of ~~the~~ multi-layer substrate 1, is prevented, since the function of circuits, arranged in ~~the~~ individual substrate layers, ~~could~~ are thereby ~~be~~ interfered with.

~~The~~ Ground surfaces 9 of ~~the~~ substrate 1, ~~preferably~~ project some tenths of a millimeter into ~~the~~ waveguide 3, ~~in order to~~ thereby increasing the positional tolerance of ~~the~~ substrate 1 with respect to ~~the~~ waveguide 3. The field configuration beneath ~~the~~ microstrip 2 in ~~the~~ waveguide 3 closely depends on the position of ~~the~~ ground surfaces 9. If the position of ~~the~~ substrate 1 is ~~now~~ slightly changed, ~~then~~ the field remains unchanged due to the positional tolerance of ~~the~~ ground surfaces 9. At an operational frequency of, for example, 10 GHz, a penetration depth of ~~the~~ ground surfaces 9 into ~~the~~ waveguide 3 of 0.5 – 1.0 mm is appropriate.

~~The~~ Multi-layer substrate 1 forms a larger virtual ground, whereby a field configuration arises which is better transformed into a waveguide wave. The field is ~~namely~~ shaped more intensely into a field component of the fundamental wave type of ~~the~~ waveguide 3 by the larger expansion of the ground (due to the many ground surfaces 9 stacked on top of one another) in the direction of the broad side of ~~the~~ waveguide 3.

It can be seen from Figures 2 and 3 that a through-plating 11 is provided at the end of ~~the~~ antenna 6 of ~~the~~ microstrip 2 extending on ~~the~~ substrate tongue 5. ~~This~~ Through-plating 11 at the end of ~~the~~ antenna 6 of ~~the~~ microstrip 2 results in a broadening of the frequency band of the transition from ~~the~~ waveguide 3 to ~~the~~ microstrip 2. ~~The~~ Through-plating ~~contact~~ 11, at the end of ~~the~~ antenna 6, ~~also becomes~~ is larger due to the thicker design of ~~the~~ substrate 1, which contributes to a more favorable conversion of the microstrip field into the waveguide field.

~~The~~ Substrate 1 is fixed to ~~a~~ Support 14 beneath ~~the~~ Opening 4 ~~14 and starting from the waveguide wall~~ by ~~means of~~ at least one screw, there being ~~are~~ two screws 12 and 13 in the embodiment shown in Figure 2. ~~In this connection, the~~ Screws 12 and 13 lie with their heads on ~~the~~ ground surfaces 7 and 8 ~~applied to the side~~ next to ~~the~~ microstrip 2 and ~~thus~~ screws 12 and 13 make an electrical contact between ~~the~~ ground surfaces 7 and 8 and ~~the~~ ground surfaces 9 superimposed on one another in ~~the~~ substrate 1 and ~~the~~ waveguide wall 14. Since ~~a~~ electrical contact is additionally made between ~~the~~ ground lines 7 and 8, applied to the upper side of ~~the~~ substrate 1, and ~~the~~ waveguide wall 14, the transmission attenuation of the transition is reduced. This contact can, as shown in Figure 2, be made by two conductive

ribbons 15 and 16, which are clamped at one end between the heads of ~~the~~ screws 12 and 13 and ~~the~~ conductive surfaces 7 and 8 and at their other end in ~~the~~ parting plane 17 of ~~the~~ waveguide 3, including ~~consisting of~~ two half shells.

Figure 3 shows another variant for effecting the electrical contact of ~~the~~ ground surfaces 7 and 8, and screws 12 and 13, with ~~the~~ waveguide wall 14. ~~Here, the~~ Waveguide 3 has a wall projection 18 above ~~its~~ opening 4 which projects over ~~the~~ ground surfaces 7 and 8 on the upper side of ~~the~~ substrate 1. One or more conductive elastic bodies 19 are clamped between ~~the~~ ground surfaces 7 and 8 on the upper side of substrate, ~~side~~ and ~~the~~ wall projection 18. One or more conductive elastic bodies 20 can also be pressed between the heads of ~~the~~ screws 12 and 13 and ~~the~~ wall projection 18.